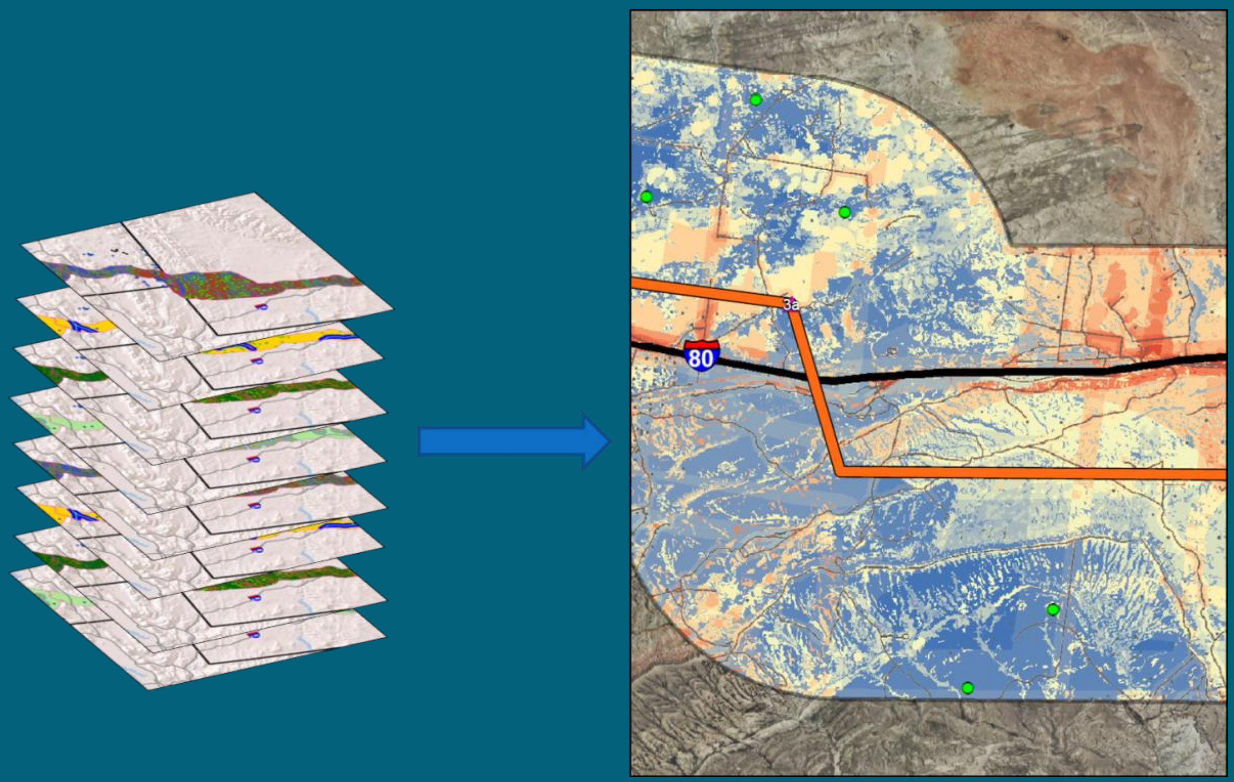
Overview of the Gateway West Habitat Equivalency Analysis



Open House
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What is HEA?

- Habitat Equivalency Analysis is a method of quantifying the permanent and interim loss of habitat services and determining an appropriate level of compensation for that loss.
  - Compensation is measured in habitat services as opposed to market currency
  - Permanent and interim losses are estimated
  - Scaled service-to-service approach (1:1)

What is HEA?

- Very simple concept
  - Define what will be impacted
  - Measure the impact or loss of that resource over time
  - Scale compensation to that loss

- A quantitative economics model

Key Benefits of HEA

- High credibility—the approach has been evaluated and documented in scientific peer-reviewed literature
- Quantitative rather than qualitative in nature
- Applicable to any ecosystem type where an appropriate habitat services metric can be defined
- Used by the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration (NOAA), U.S. Environmental Protection Agency (USEPA), U.S. Army Corp of Engineers (USACE), U.S. Forest Service, and the European Union

U.S. Examples

- Holden Mine Site Cleanup Natural Resource Damage Assessment (includes a HEA) (USFS; January 2012)
- Resource Equivalency Analysis (REA) for Marbled Murrelets, New Carissa Spill, February 1999 (BLM, USFWS, USDOI; May 24, 2005)
- Genesis Crude Oil. L.P. Oil Spill: Resource Equivalency Analysis (REA) for Lost Services and Restoration for Ducks Lost (Mississippi Department of Environmental Quality; December 2003)
- Leviathan Mine Natural Resource Damage Assessment Plan (includes an REA) (Washoe Tribe, USBIA, USFS, CDFG, NDEP; December 2003)
- Kinder Morgan Suisun Marsh Diesel Fuel Pipeline Break Oil Spill (April 27, 2004) Damage REA (NOAA; September 2004)
- Discharge of Oil from the M/V COSCO BUSAN into San Francisico Bay, November 7, 2007 REA. (NOAA; September 2011)
- Miami Harbor General Reevaluation Report and Final Environmental Impact Statement (includes a HEA) (USACE; 2002).
- Broward County Shore Protection Project Environmental Impact Statement (includes a HEA) (USACE; 2003)
- Blackbird Mine HEA to compensate for impacts to a salmon stream (Chapman, Iadanza, and Penn 1998)
- Salt Marshes of Lake Barre, Louisiana HEA (Penn and Tomasi 2002)
- HEA for Seagrass restoration (Fonesca, Julieus, and Kenworthy 2000)
- HEA for Coral Reef restoration (Milton and Dodge 2001)

Upheld in Court

- Court Cases in the US have confirmed the validity of the HEA approach for scaling compensatory restoration
  - United States v. Melvin A. Fisher et al 1992
  - United States v. Great Lakes Dredge and Dock et al. 2001
  - United States v Union Pacific Railroad 2008

(per Cole 2010)

Today's Presentation

- Overview of HEA Concept
- Gateway West Transmission Line HEA
  - Development of Service Metric
  - Mapping Baseline Habitat Services
  - Modeling Impacts and Restoration
  - Mitigation Measures

Habitat Services

- Habitat services include those ecosystem features and ecosystem functions that support wildlife and human populations (King 1997)
  - Ecosystem features
    - physical site-specific characteristics of an ecosystem
    - Examples include soil type, vegetative ground cover, water quality
  - Ecosystem functions
    - The biophysical processes that actually occur within an ecosystem
    - Examples include fish and wildlife habitat, water filtration, carbon cycling, nutrient uptake

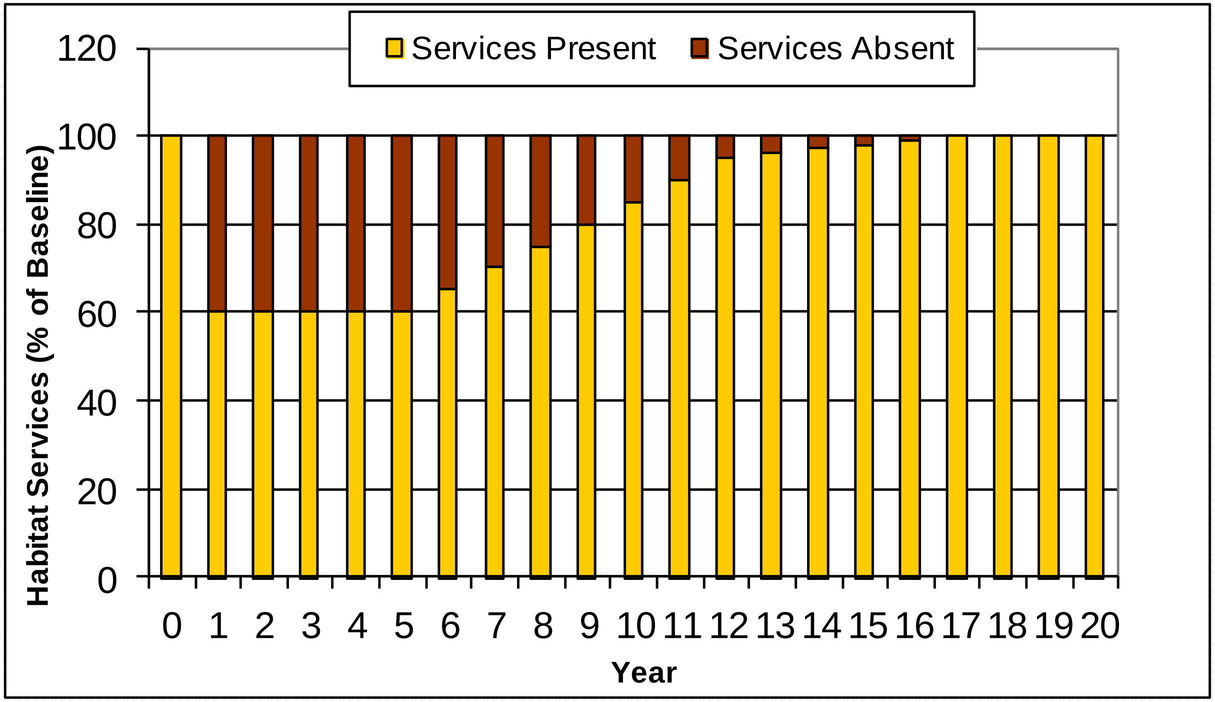
Defining Habitat Services

- Quantifying all habitat services provided by an ecosystem, while ideal, is too complex
- Narrow the focus to the habitat services of primary importance
- Develop a metric (surrogate measure) for those primary habitat services
  - Needs to capture changing value of the habitat
  - Baseline habitat service level is calculated by applying the metric to the project area before project initiation

Assigning Project Impacts

- Direct and indirect impacts are applied to baseline habitat service level
- Impacts models are constructed only for milestone periods (construction, reclamation, recovery)
- Define a rate of change between modeled milestone periods

Changes in Habitat Service Level



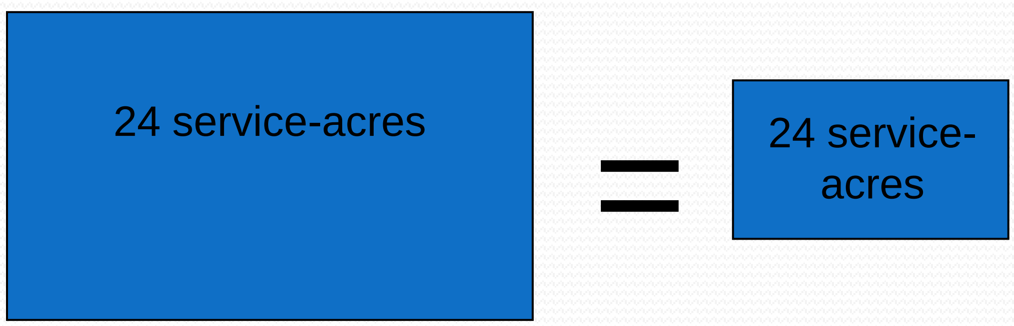
- Sum of the red bars is the interim service loss
- Interim service loss = Gain from mitigation measures

Projects to Offset Injury: Mitigation

- Gain is measured using the same habitat service metric
  - Goal is to return injured landscape to baseline
  - Habitat services lost = habitat services gained
- Replace services with like services
  - 1:1 scaling by service
  - Should benefit the injured population

Service-to-Service Scaling

- HEA uses a service-to-service approach rather than an acre-to-acre approach
- Does not assume a one-to-one trade-off in resources (e.g., number of acres), but instead in the habitat services they provide

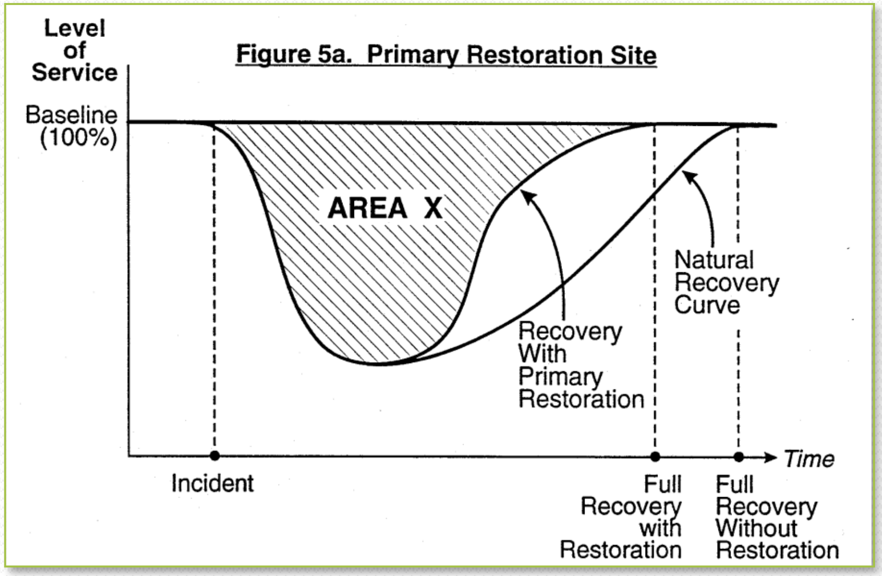


8 acres of service level 3 habitat

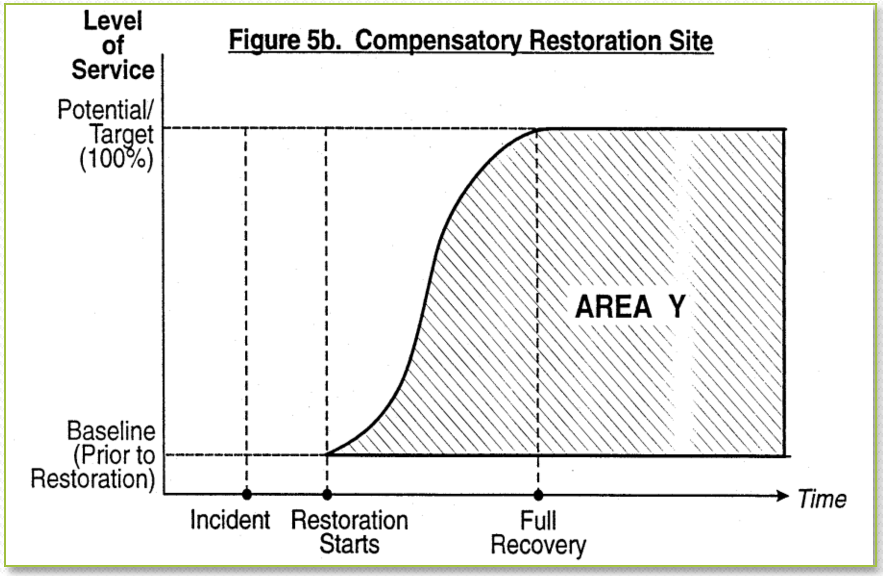
4 acres of service level 6 habitat

Area X = Area Y

Injury



Compensatory Restoration (mitigation)



(from King 1997)

Habitat Compensation Equation

$$\left[\sum_{t=0}^{B} \mathrm{V}^{\mathrm{j}} * \rho_t * \left\{\left(b^j - x_t^j\right) / b^j\right\}\right] * J = \left[\sum_{t=I}^{L} \mathrm{V}^{\mathrm{p}} * \rho_t * \left\{\left(x_t^p - b^p\right) / b^j\right\}\right] * P$$

where t refers to time (in years):
$t = 0$, the injury occurs; $t = B$, the injured habitat recovers to baseline; $t = I$, habitat replacement project begins to provide services; $t = L$, habitat replacement project stops yielding services

V^j is the annualized per unit value of the services provided by the injured habitat (without injury)

V^p is the annualized per unit value of the services provided by the replacement habitat

x_t^j is the level of services per unit provided by the injured habitat at the end of year t

b^j is the baseline (without injury) level of services per unit of the injured habitat

x_t^p is the level of services per acre provided by the replacement habitat at the end of year t

b^p is the initial level of services per unit of the replacement habitat

ρ_t is the discount factor, where $t = 1/(1+r)t-C$, and r is the discount rate for the time period

J is the number of injured units

P is the size in acres of the replacement project that equates the losses with the gains from restoration.

The Product of HEA

$$\left\lfloor \sum_{t=0}^{B} \mathrm{V}^{\mathrm{j}} * \rho_t * \left\{\left(b^j - x_t^j\right)/b^j\right\}\right\rfloor * J = \left\lfloor \sum_{t=I}^{L} \mathrm{V}^{\mathrm{p}} * \rho_t * \left\{\left(x_t^p - b^p\right)/b^j\right\}\right\rfloor * P$$

P is the size in acres of the replacement projects that equate the losses with the gains from restoration and mitigation.

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Developing the Gateway West Sage-grouse Habitat Services Metric

- Collaboration of personnel from multiple agencies (HEA Technical Advisory Team)
  - SWCA proposed a draft metric
  - Team held a series of meetings to refine the metric
    - Based on agency observations
    - To incorporate the most recent literature
    - To conform to available data
  - SWCA mapped the baseline habitat services using the refined metric
  - Team reviewed baseline maps and the metric was refined again
  - Team came to a consensus that the metric adequately represented the variability in the habitat services across the project area

Habitat Service Metric

	Variables	3	2	1	0
VAR01	Distance to interstate highway or federal highway (meters)	>5,000	700-5,000	100–700	<100
VAR02	Distance to county/state highway or heavily travelled gravel road, well pads, or mine footprints (meters)	>200	50-200	25–50	<25
VAR03	Distance to fence (kilometers)	>2.0	0.4-2.0	<0.4	NA
VAR04	Vegetation class	NA	NA	All vegetation types except those identified as scoring 0	forested, urban, open water, roads, well pads, mine footprints, other surface disturbances
VAR05	% slope	<10	10–30	30–40	>40
VAR06	Distance to occupied lek (kilometers)	0-5	5-8.5	>8.5	NA
VAR07	Sagebrush patch size (hectares)	>130	10-130	<10	NA
VAR08	% sagebrush cover	15-25	5–15 or >25	<5	NA
VAR09	Sagebrush canopy height (centimeters)	30-80	20 to <30 or >80	<20	NA
VAR10	% bunchgrass cover	5–15	2–5 or >15	<2	NA
VAR11	Distance of habitat to sage or shrub dominant (meters)	<90	90-275	>275	NA

Habitat Service Metric

Four possible scores for each variable

Variables		3	2	1	0
VAR01	Distance to interstate highway or federal highway (meters)	>5,000	700-5,000	100–700	<100
VAR02	Distance to county/state highway or heavily travelled gravel road, well pads, or mine footprints (meters)	>200	50-200	25–50	<25
VAR03	Distance to fence (kilometers)	>2.0	0.4-2.0	<0.4	NA
VAR04	Vegetation class	NA	NA	All vegetation types except those identified as scoring 0	forested, urban, open water, roads, well pads, mine footprints other surface disturbances
VAR05	% slope	<10	10–30	30–40	>40
VAR06	Distance to occupied lek (kilometers)	0-5	5-8.5	>8.5	NA
VAR07	Sagebrush patch size (hectares)	>130	10-130	<10	NA
VAR08	% sagebrush cover	15-25	5–15 or >25	<5	NA
VAR09	Sagebrush canopy height (centimeters)	30-80	20 to <30 or >80	<20	NA
VAR10	% bunchgrass cover	5–15	2–5 or >15	<2	NA
VAR11	Distance of habitat to sage or shrub dominant (meters)	<90	90-275	>275	NA

Anthropogenic variables

Habitat exclusion variable

Slope and proximity to lek

Vegetation variables

Simple additive model: Score = Var04*sum(Var01,02,03,05,...Var11)

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Data Acquisition and Review

- Numerous public and project-specific digital datasets were used

  Anthropogenic
  - Fence lines & Allotment Boundaries
  - Coal, Mining, & Oil/Gas Disturbance Areas,
  - Municipalities
  - Transportation
  - Proposed Transmission Infrastructure

  Natural
  - Hydrology (bodies of water, 2-sided rivers)
  - Greater Sage-grouse Leks
  - Elevation Derivatives (Slope)
  - Vegetation Type, Cover, Height (GAP, and Landfire)
  - Other Vegetation Studies (University of WY, BLM, USFWS)

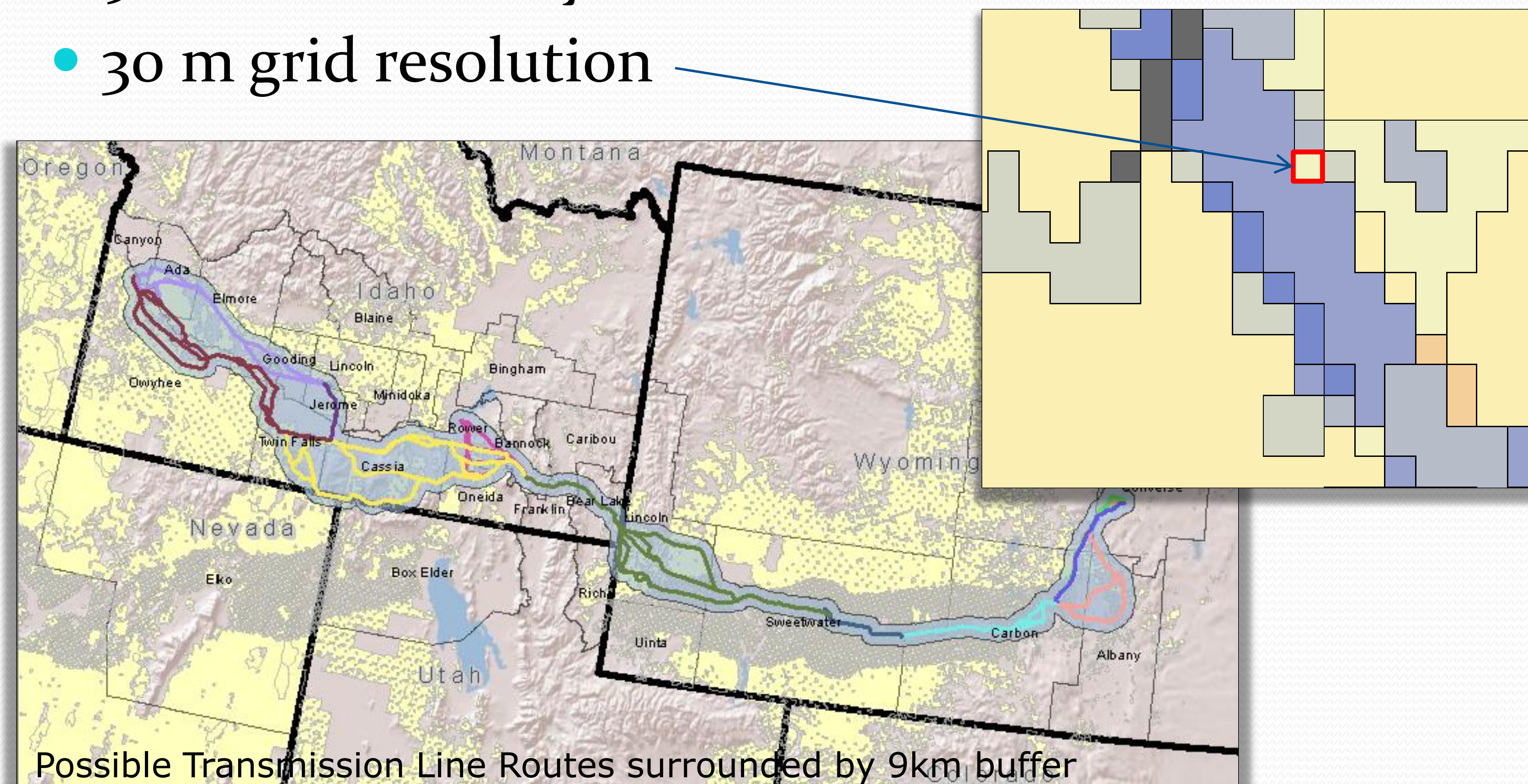
  Wildlife
  - Greater Sage-grouse Leks

GIS Modeling

- The metric was modeled in a GIS platform to produce data inputs for the HEA
  - Each variable was modeled separately
  - A grid was superimposed over the analysis area and each cell of the grid was scored separately
  - The sum of the variable scores is the habitat service score for the cell
  - The habitat service scores from all the cells in the analysis area are summed separately for each segment

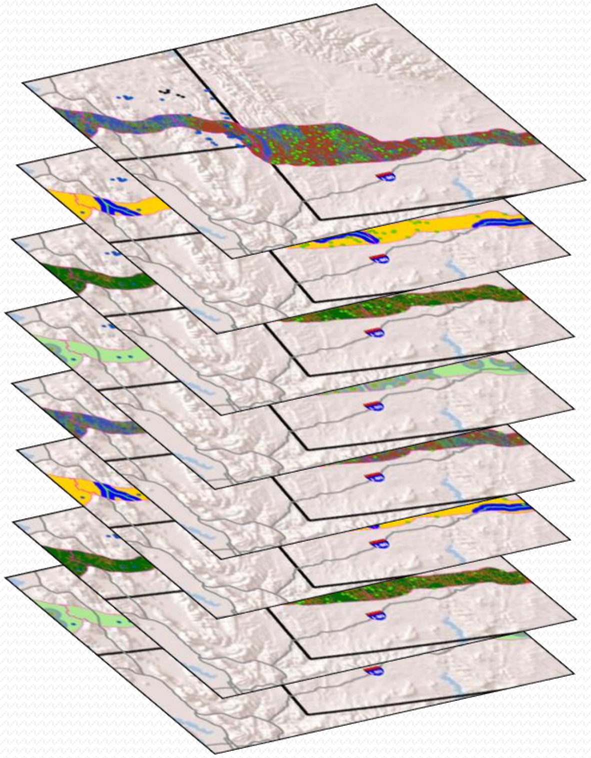
Analysis Area and Data Resolution

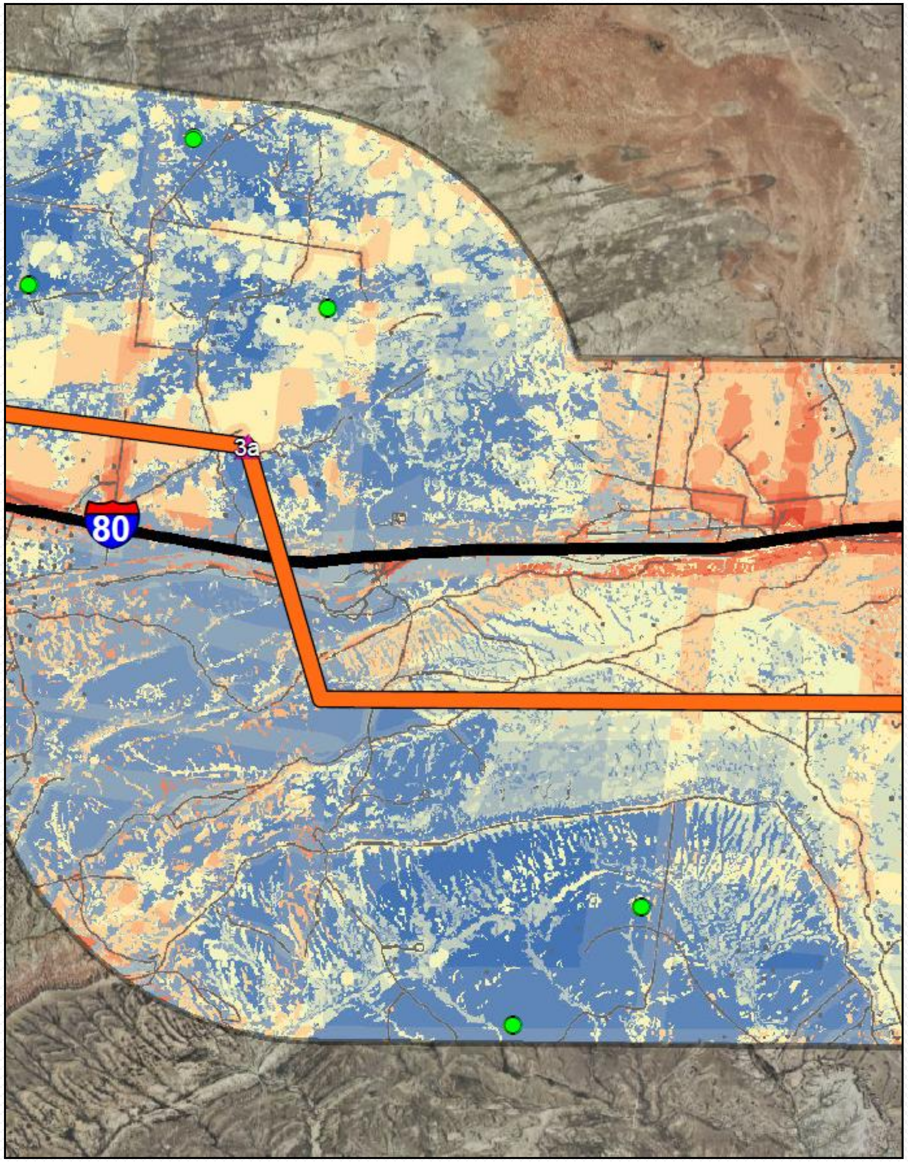
- 9 km buffer Analysis Area
- 30 m grid resolution



Possible Transmission Line Routes surrounded by 9km buffer

Baseline Habitat Services Map





Var1+Var2+...+Var11 = Baseline

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Project Milestones

- **Baseline**—Pre-construction
- **Construction—**Habitat services available during the construction of the substations and transmission line.
- **Restoration**—Habitat services available to sage-grouse after substation and transmission line construction is complete, habitat restoration has begun, and some services return with the reduction in noise and human presence.
- **Recovery**—The recovery milestone quantifies habitat services available to sage-grouse after a vegetation type has recovered to the greatest extent expected after Project restoration is complete.

Assigning Impacts

- WHEN: Impact and Restoration Schedule developed from Construction Schedule provided by RMP/IP
  - Developed by segment
- WHAT: Types of impacts modeled were decided by the HEA Technical Advisory Team
  - Direct impacts (vegetation removal)
  - Indirect disturbance (noise, human activity)

Assigning Impacts

- WHERE: Footprint of direct impacts developed from DEIS
- HOW: Indirect impact layers developed for types of project infrastructure
  - Staging areas, transmission lines, access roads, fly yards, pulling stations, etc. have impacts during construction because of noise and human presence (equal to a secondary road)
  - Substations and regeneration sites assumed to have permanent impact (equal to a secondary road)

Habitat Restoration

- Restoration will return majority of areas back to baseline habitat services over time
  - Time for recovery is dependent on vegetation type and type of disturbance
  - Some disturbances (substations, footprint of transmission structures, regeneration stations) will be permanent

- Services will return based on shape and duration of vegetation recovery curves
  - Duration of the analysis period is determined by vegetation recovery to baseline
  - Analysis period set to 100 years after construction is complete to allow for sagebrush re-growth

Infrastructure-Specific Reclamation

- Substations, regeneration stations, structure footprint have no reclamation and will remain disturbed
- Fly yards, pulling stations, and staging areas will return to baseline following the recovery curve for the vegetation type in which they are placed

Infrastructure-Specific Reclamation

- Disturbance areas surrounding transmission structures will return to baseline following vegetation recovery curves
  - Will transition from fully disturbed to 2.5% disturbed to account for structure footprint
- Road under transmission line will become tertiary road after construction and will have same long-term impact as other tertiary roads in model

Simulated Project Milestones

Project Year 0 (Baseline)

5	5	6	5	4	3	4	5	4	6	7
5	5	6	5	4	3	4	4	4	7	9
6	6	6	5	3	3	3	4	6	7	9
6	2	2	1	3	3	4	5	6	7	8
5	5	4	4	5	5	7	6	8	7	8
4	4	4	6	7	8	6	7	7	8	9
5	4	3	8	7	8	7	8	9	8	9
7	8	7	8	9	9	5	6	6	5	4
6	7	9	2	5	4	4	6	2	5	4
6	7	8	2	1	4	3	6	2	4	4
7	5	5	4	1	4	3	5	4	4	3

Project Year 1 (Construction)
55.6% of Baseline

0	0	0	1	2	2	4	5	4	6	7
0	0	0	1	2	2	2	4	4	7	9
1	1	1	1	1	2	2	4	6	7	9
2	2	2	1	0	2	2	2	6	7	8
5	2	2	2	1	1	2	2	2	7	8
4	4	2	2	2	1	1	2	2	2	9
5	4	3	2	2	1	0	1	2	2	2
7	8	7	2	2	2	1	1	1	2	2
6	7	9	2	2	2	2	1	0	1	2
6	7	8	2	1	2	2	2	1	1	1
7	5	5	4	1	4	2	2	2	1	1

Indirect impact buffer around active construction areas, substations, etc.

Direct impacts: Disturbed areas have no service value in model

Simulated Project Milestones

Project Year 4 (Restoration)
87.9% of Baseline

0	0	0	2	2	3	4	5	4	6	7
0	0	0	1	2	3	4	4	4	7	9
2	2	1	1	1	3	3	4	6	7	9
2	2	2	1	0	3	4	5	6	7	8
5	5	4	4	5	5	7	6	8	7	8
4	4	4	6	7	8	6	7	7	8	9
5	4	3	8	7	8	0	8	9	8	9
7	8	7	8	9	9	5	6	6	5	4
6	7	9	2	5	4	4	6	0	5	4
6	7	8	2	1	4	3	6	2	4	4
7	5	5	4	1	4	3	5	4	4	3

Project Year 104 (Recovery)
88.5% of Baseline

0	0	0	1	2	3	4	5	4	6	7
0	0	0	1	2	3	4	4	4	7	9
1	1	1	1	2	3	3	4	6	7	9
2	2	2	2	1	3	4	5	6	7	8
5	5	4	4	5	5	7	6	8	7	8
4	4	4	6	7	8	6	7	7	8	9
5	4	3	8	7	8	3	8	9	8	9
7	8	7	8	9	9	5	6	6	5	4
6	7	9	2	5	4	4	6	1	5	4
6	7	8	2	1	4	3	6	2	4	4
7	5	5	4	1	4	3	5	4	4	3

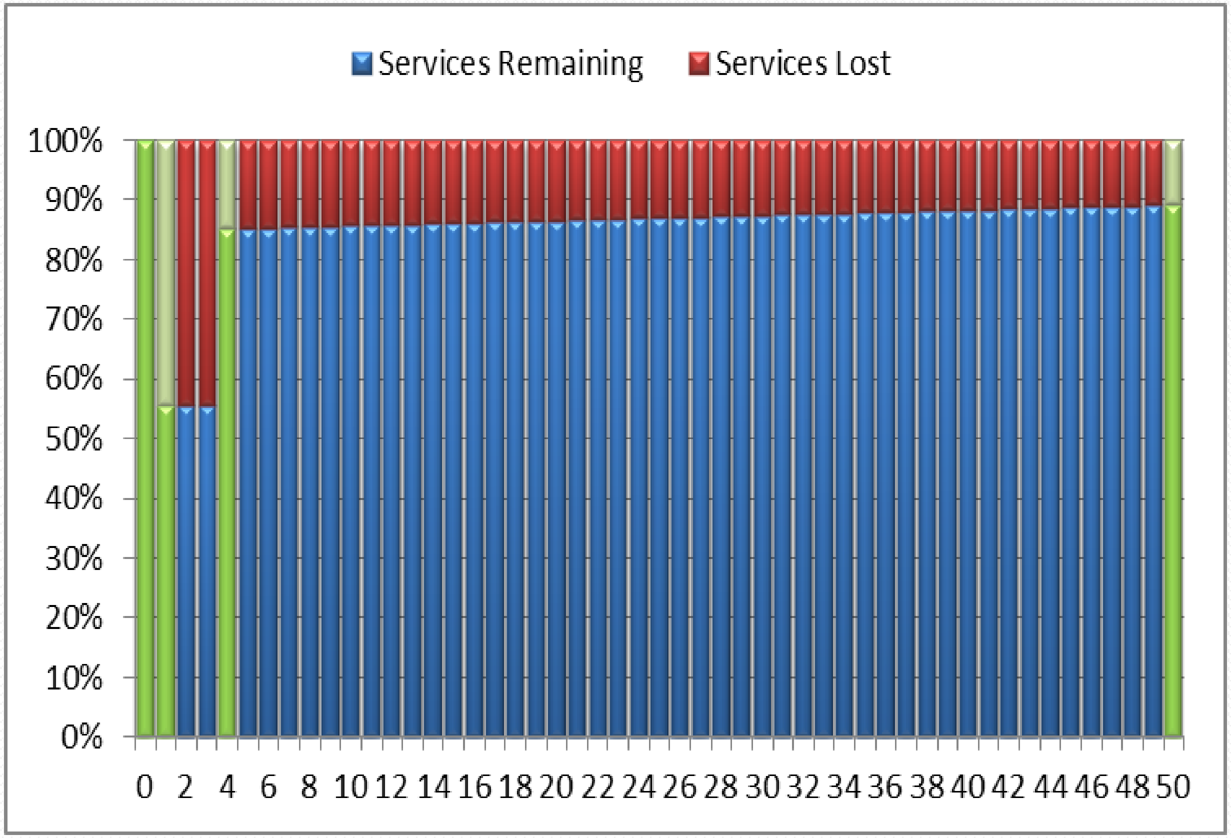
Indirect impact buffer around substations and regeneration facilities

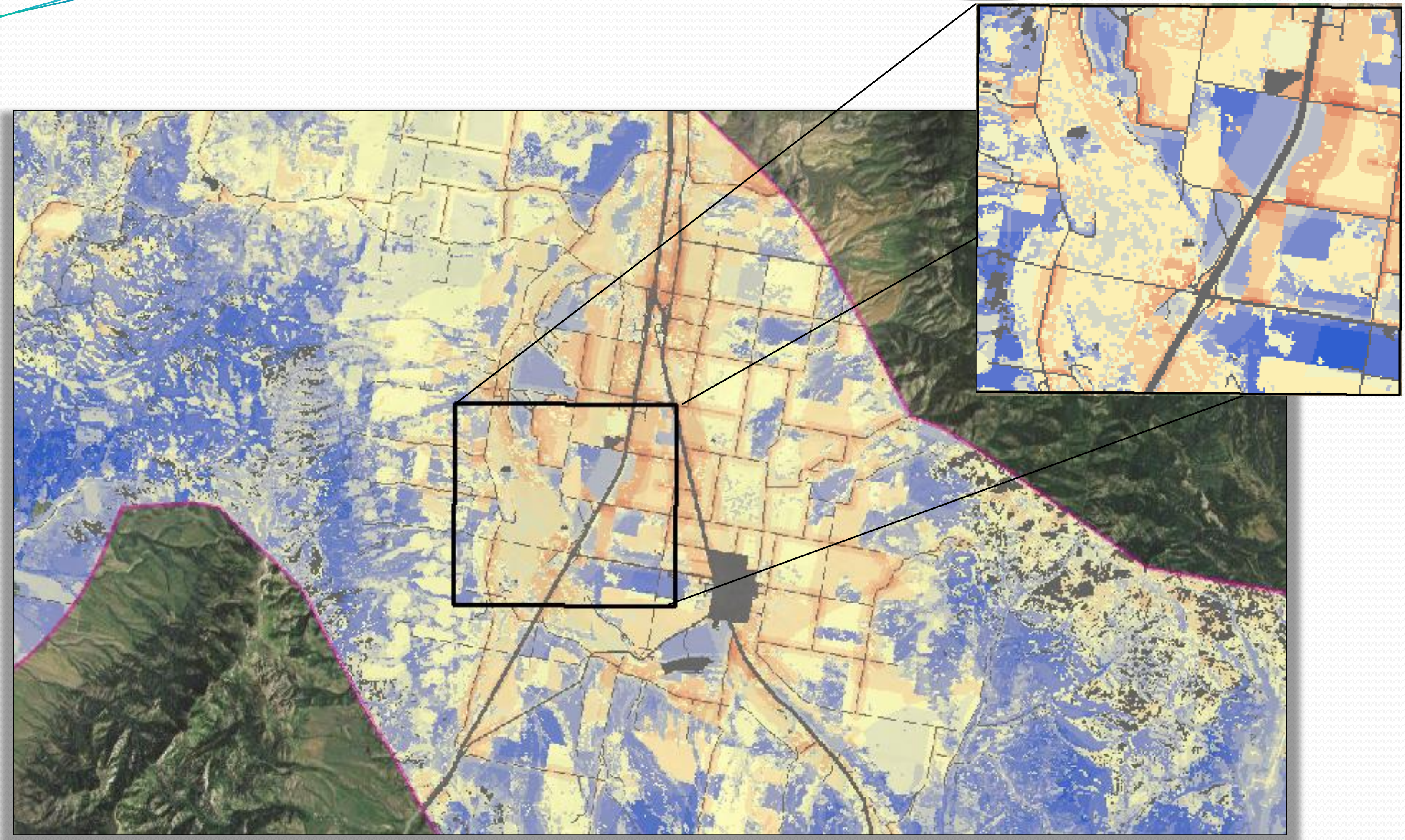
Direct impacts: Disturbed areas have not returned to baseline because of transmission structures

Project Year	Habitat Services	% of Baseline
0	640.0	100.0%
1	356.0	55.6%
2	356.0	55.6%
3	356.0	55.6%
4	545.0	85.2%
5	545.6	85.2%
6	546.1	85.3%
7	546.7	85.4%
8	547.3	85.5%
9	547.8	85.6%
10	548.4	85.7%
11	549.0	85.8%
12	549.5	85.9%
13	550.1	86.0%
14	550.7	86.0%
15	551.2	86.1%
16	551.8	86.2%
17	552.3	86.3%
18	552.9	86.4%
19	553.5	86.5%
.	.	.
.	.	.
.	.	.
30	559.7	87.5%
31	560.3	87.5%
32	560.8	87.6%
33	561.4	87.7%
34	562.0	87.8%
35	562.5	87.9%
36	563.1	88.0%
37	563.7	88.1%
38	564.2	88.2%
39	564.8	88.2%
40	565.3	88.3%
41	565.9	88.4%
42	566.5	88.5%
43	567.0	88.6%
44	567.6	88.7%
45	568.2	88.8%
46	568.7	88.9%
47	569.3	89.0%
48	569.9	89.0%
49	570.4	89.1%
50	571.0	89.2%

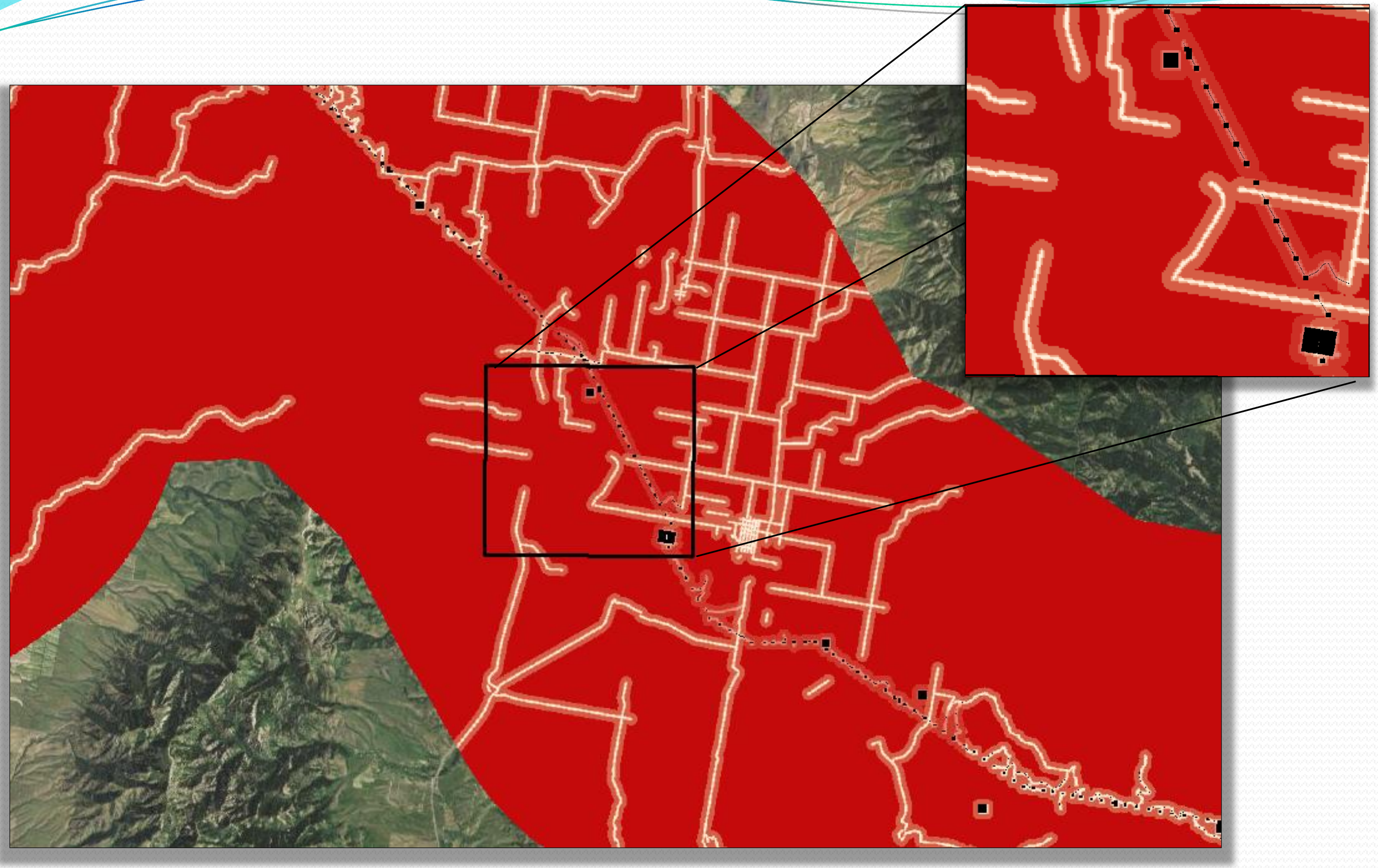
Milestone service levels are input to the HEA spreadsheet model

This analysis assumed a linear recovery of services between milestones (colored green).

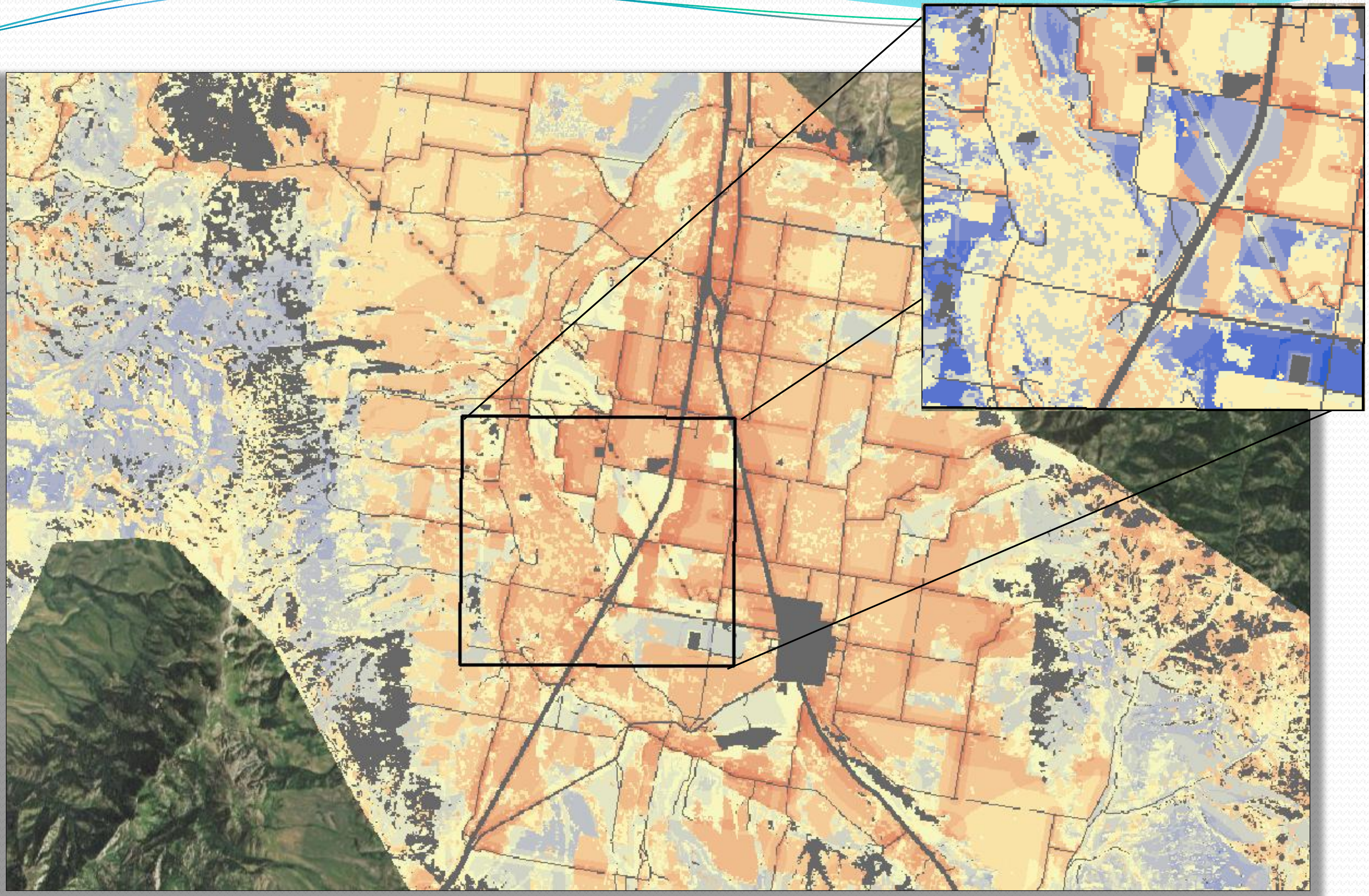




Baseline Milestone



Direct and Indirect Impact Buffers



Construction Milestone

Changing Habitat Services – Segment 5p

Comparison of habitat service level at each milestone in HEA (provisional numbers)

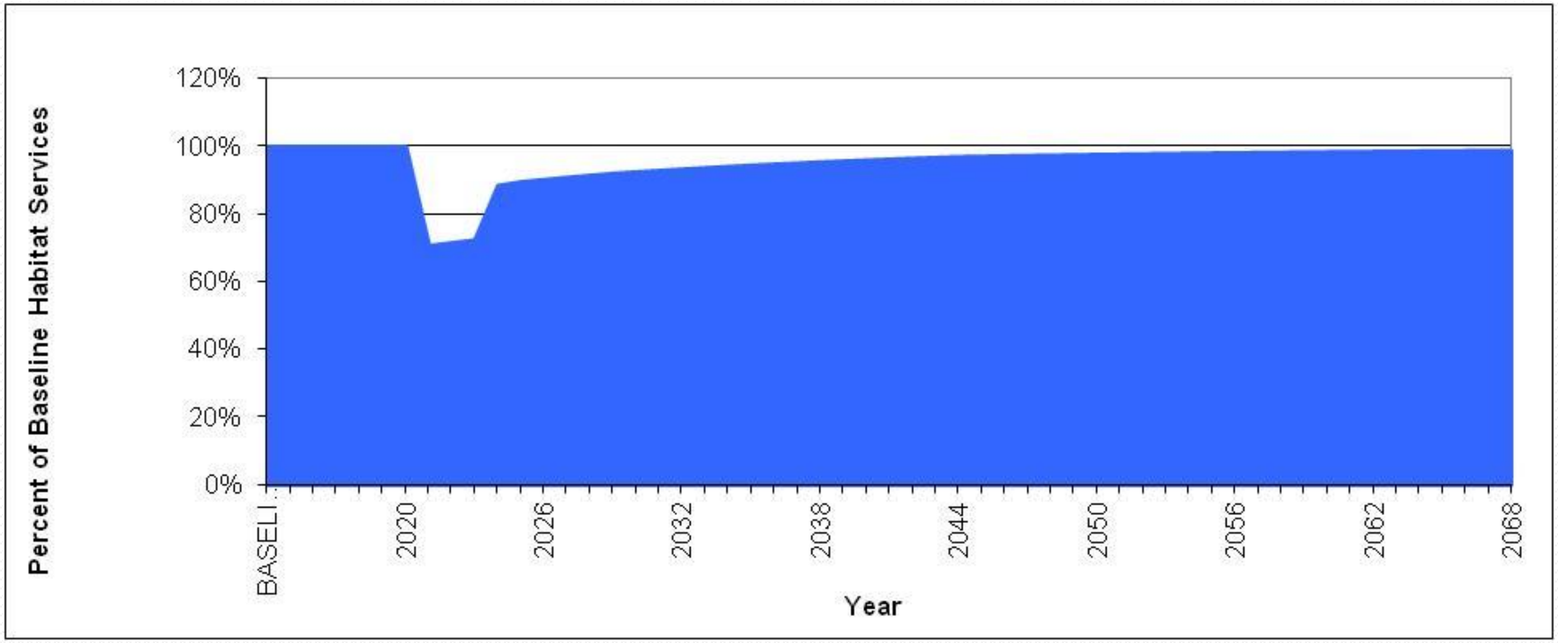
	ROW (76 m, centered)	3 km buffer	6 km buffer	9 km buffer
Baseline	692	49,697	105,198	179,054
Construction	447	46,669	100,163	171,032

Comparison of percent of baseline remaining at each milestone in HEA (provisional numbers)

	ROW (76 m, centered)	3 km buffer	6 km buffer	9 km buffer
Baseline	100%	100%	100%	100%
Construction	65%	94%	95%	96%
Restoration	85%	98%	99.4%	99.5%
Recovery	99%	99.9%	99.9%	99.9%

Proposed Action Impacts – Segment 5p

- Over the total analysis period (out to 2124), 2.72% of all services in ROW would be lost
- In the first 10 years (2021-2031), 14.29% of all services in the ROW would be lost
- Represents the percent services that would need to be compensated for



(provisional)

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Mitigation

- Should offset permanent and interim habitat service losses over the analysis period (measured in service-acre-years)
- Habitats with higher service values will be more costly to mitigate than those with lower service values

Mitigation Approach

- GIS simulation of potential habitat enhancement or restoration projects to estimate benefit in habitat services
- Determine average cost per unit for each based on real projects in Idaho and Wyoming
- Calculate average price per services gained for each project type

Mitigation Projects

- Projects were selected by the HEA Technical Advisory Team
  - Fence marking/modification
  - Sagebrush restoration/reclamation
  - Conifer/juniper removal
  - Grass/forb enhancement
  - Conservation easements
- Benefit of projects must be measured by the habitat service metric

Simulating Mitigation

Project Year 50 (Operation)
88.5% of Baseline
Reclamation w/out mitigation

0	0	0	1	2	3	4	5	4	6	7
0	0	0	1	2	3	4	4	4	7	9
1	1	1	1	2	3	3	4	6	7	9
2	2	2	2	1	3	4	5	6	7	8
5	5	4	4	5	5	7	6	8	7	8
4	4	4	6	7	8	6	7	7	8	9
5	4	3	8	7	8	3	8	9	8	9
7	8	7	8	9	9	5	6	6	5	4
6	7	9	2	5	4	4	6	1	5	4
6	7	8	2	1	4	3	6	2	4	4
7	5	5	4	1	4	3	5	4	4	3

Project Year 50 (Operation)
92.3% of Baseline
Reclamation with mitigation

0	0	0	1	2	3	4	5	4	6	7
0	0	0	1	2	3	4	4	4	7	9
1	1	1	1	2	3	3	4	6	7	9
2	2	2	2	1	3	4	5	6	7	8
5	5	4	4	5	5	7	6	8	7	8
4	4	4	6	7	8	6	7	7	8	9
5	4	3	8	7	8	3	8	9	8	9
7	8	7	8	9	9	5	6	6	5	4
6	7	9	4	7	6	6	6	1	5	4
6	7	8	4	3	6	5	6	2	4	4
7	5	5	6	3	6	5	5	4	4	3

Mitigation Scaled to Offset Impacts

- The proponent, BLM, and agencies will evaluate the services returned per project type, compare those to the services lost as a result of the project, and develop an appropriate mitigation plan to compensate for services lost

Questions and Discussion